CONTINUOUS MAT MAKING PROCESS AND PRODUCT

TECHNICAL FIELD

The present disclosure relates to a continuous process for making floor mats having a textile upper surface and a rubber or rubber-like backing. In the one embodiment of the present process, a continuous roll of unvulcanized rubber is joined to a continuous roll of textile material during vulcanization. In an alternate embodiment, textile panels are positioned onto a continuous roll of unvulcanized rubber, later being joined during vulcanization. After vulcanization of either a textile roll or textile panels to a rubber backing, the resultant mat composite is cut into individual mat units.

BACKGROUND

Dust control mats, which have a textile side and a rubber or rubber-like backing, are generally used in access ways where people tend to brush or scrape their feet to prevent carrying moisture and/or dirt into other areas of the premises. Normally, these mats are located in areas of high pedestrian traffic such as doorways. In many cases, these mats are part of an industrial laundry inventory, being rented to customers and serviced by the laundry. On some frequency (e.g., weekly), the laundry collects soiled mats, launders them, and then returns them to the customer. It is important, therefore, that these mats be capable of withstanding rigorous and routine laundering.

In the past, manufacture of these textile-rubber mats has been a time-consuming, labor-driven process. Both the textile material and the unvulcanized rubber sheeting must be cut to the desired dimensions. The textile panel is positioned over the rubber panel on a conveyor belt, and the stacked pair is carried into a vulcanizing chamber. After vulcanization, the

individual mat units are created. In some instances, the mats must be trimmed to remove rubber that has spread unevenly during vulcanization.

The present process provides for the feeding of continuous rolls of textile material and unvulcanized rubber into the vulcanization chamber. Once vulcanized, the mat composite is carried through a cutting station where individual mat units are created. Such a process provides greater mat making efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a schematic representation of the prior art process for producing a textile-faced rubber mat;

FIG. 1B is a plan view of the textile-faced rubber mat, as may be produced by the process of **FIG. 1A**;

FIG. 2A is a schematic representation of the present process for producing a textile-faced rubber mat, including a continuous roll of textile material and a continuous roll of unvulcanized rubber;

FIG. 2B is a schematic representation of an alternate embodiment of the present process for producing a textile-rubber mat, including a plurality of textile panels and a continuous roll of unvulcanized rubber;

FIG. 3A is a cross-section of a textile-faced rubber mat, as produced by the process of **FIG. 2A**;

FIG. 3B is a cross-section of a textile-faced rubber mat, as produced by the process of **FIG. 2B**;

FIG. 4A is a plan view of a layout of mats in accordance with the process of **FIG. 2A**; and **FIG. 4B** is a plan view of a layout of mats in accordance with the process of **FIG. 2B**.

DETAILED DESCRIPTION

FIG. 1A describes the prior art process for making a dust control mat having a textile upper surface and a rubber or rubber-like backing. In **FIG. 1A**, a textile substrate is cut into panels **6** at fabric cutting station **10**. As shown, textile panels **6** comprise a tufted substrate. Unvulcanized rubber is cut into panels **8** at rubber cutting station **12**. Textile panel **6** is positioned over rubber panel **8** in a staging area 50 along conveyor **90**. Generally, textile panel **6** is centered on rubber panel **8**, thereby creating a uniform border around the perimeter of mat **20**.

The stacked panels **6**, **8** are conveyed into a vulcanization chamber **60** where rubber panel **8** is softened and subsequently hardened to secure rubber panel **8** to textile panel **6**. The first twelve to fifteen inches of vulcanization chamber **60** will be described herein as entry area **58**. Entry area **58** is not subject to the pressures realized in vulcanization chamber **60**, because of the shape of the diaphragm of the vulcanization press.

It was believed, heretofore, that entry area **58** needed to be a pre-heat area, designed to raise the temperature of textile panel **6** for improved cycle time. Therefore, as shown in **FIG. 1A**, entry area **58** is subject to temperatures near those of vulcanization conditions. The problem often encountered with such an approach, however, is that rubber panel **8** tends to pre-cure whenever processing delays cause rubber panel **8** to remain in entry area **58** for an extended time. This pre-curing prevents adequate adhesion between textile panel **6** and rubber panel **8**, resulting in a flawed mat product.

Turning now to **FIG. 2A**, a continuous roll **20** of textile material **22** and a continuous roll **30** of unvulcanized rubber **32** are fed onto staging area **50** of conveyor **90**. In one embodiment, conveyor **90** is perforated to act as a molding apparatus, in addition to being a carrier for mat components. During vulcanization, rubber layer **32** softens and moves into the perforations in conveyor **90**, thereby creating cleats in the bottom of rubber layer **32**. This process is described in US Patent 6,303,068 to Kerr et al., which is incorporated herein by reference. In a preferred

embodiment, textile substrate **22** has approximately the same width as that of rubber **32**. In an alternate embodiment, rubber **32** is wider than tufted substrate **22**.

In **FIG. 2B**, an alternate process is shown, using a continuous roll **30** of unvulcanized rubber **32** with pre-cut textile panels **6**. The process represented by **FIG. 2B** results in a mat **42** having a rubber border around its perimeter (similar to that of **FIG. 1B**). However, because of the continuous roll **30** of rubber **32**, greater production efficiency is achieved.

Textile material **22** and textile panels **6** are shown as tufted substrates, although other textile constructions may be utilized, including woven, non-woven, and knitted constructions. Textile material **22** and textile panels **6** may be comprised of nylon, polyester, polypropylene, cotton, and other natural and synthetic fibers as may be known in the art. A preferred fiber is nylon. Textile material **22** and textile panels **6** may be printed before or after incorporation into mat **40** or mat **42**, respectively. Further, textile material **22** and textile panels **6** may be comprised of solution-dyed yarns.

Rubber layer **32**, as used in the process of **FIGS. 2A** and **2B**, is comprised of acrylonitrile-butadiene rubber (NBR), styrene-butadiene rubber (SBR), carboxylated NBR, carboxylated SBR, ethylene-propylene-diene monomer rubber (EPDM), and blends thereof, all merely as examples. A preferred rubber composition is NBR rubber, sold under the name EXP-00861 by Associated Rubber Company of Tallapoosa, Georgia. Preferred thicknesses of rubber layer **32** are in the range of about 15 mils to about 200 mils, with a more preferred thickness of about 60 mils. It should be understood that rubber layer **32** may further comprise multiple layers of various or similar rubbers, including foam rubber layers if desired. Vulcanization temperatures and cycle time may require adjustment accordingly depending on the number and type of layers used.

Turning again to **FIGS. 2A** and **2B**, entry area **58** has a temperature considerably less than that of vulcanization chamber **60**. Cooling water is circulated around entry area **58**, causing the temperature in entry area **58** to be in the range of about 90 °F to about 110 °F. By

establishing entry area **58** as a "cool zone," the mat components are not subjected to the temperature and pressure differentials that may result in pre-curing of rubber **32**. Rather, after mat components **22, 32** move through entry area **58**, components **22, 32** are subjected to uniform pressure and temperature in vulcanization chamber **60**. The first twelve inches of entry area **58** are not subject to uniform pressure and are maintained at a temperature of about 90 °F to about 110 °F. The next three inches (inches 12 to 15) of entry area **58** experience a temperature gradient from low temperatures of about 90 °F to about °110 F to high temperatures of about 360 °F to about 400 °F.

During vulcanization, rubber layer **32** softens; pressure is applied to layers **22**, **32**, thereby pressing textile layer **22** into rubber layer **32**; and then rubber layer **32** hardens, securing layers **22**, **32** together. Similarly, textile panels **6** are also pressed into rubber layer **32** and are secured. Vulcanization typically occurs at a temperature in the range of about 280 °F to about 440 °F, with a preferred temperature of about 360 °F. The pressures used in vulcanization are typically in the range of about 15 p.s.i. to about 50 p.s.i., with a preferred pressure of about 40 p.s.i. With the temperatures and pressures described herein, cycle time for vulcanization is typically between about 2 minutes and about 20 minutes, with a cycle time of 4 minutes being expected under preferred vulcanization conditions.

Having undergone vulcanization, textile substrate **22** and rubber layer **32** comprise a mat composite **34**. Mat composite **34** is then conveyed through a backing perforation station **65** into a cutting station **70**, in which composite **34** is cut into individual mats **40**. In **FIG. 2B**, textile panels **6** are adhered to rubber layer **32** to create composite **36**, which is also conveyed through cutting station **70** for the production of individual mat units **42**. Backing perforation station **65** includes a spiked roll over which mat composite **34** or **36** is run. The spikes in the roll penetrate the backing of mat composite **34** or **36**, creating micro-valves that aid in the removal of water

from the finished mat during laundering. Backing perforation station **65** is described in US Patent 4,653,366 to Nichols et al., which is incorporated herein by reference.

A printed mat may be created in a number of ways. In one embodiment, the roll **20** of textile material **22** is printed before the mat assembly process. In an alternate embodiment, composite **34** is printed before entering cutting station **70**. In yet another embodiment, mats **40** are printed after assembly is completed. Printing may be included as part of the continuous process of the present disclosure.

Because of the pressures of vulcanization, it is not abnormal for textile component (either **22** or **6**) to appear crushed. This is particularly true when textile component **22** or **6** is comprised of a tufted substrate. Pile height may be restored by washing, brushing, or vacuuming finished mat **40** or **42**.

FIG. 3A shows a cross–section of mat **40**, in which textile layer **22** and rubber layer **32** have approximately the same width. Mat **40**, therefore, is a borderless mat. In an alternate embodiment, mat **40** may have borders on one or two edges. These borders are created along edges where the dimensions of rubber layer **32** exceed that of textile substrate **22**. Whether the mat **40** is bordered on one or two edges depends on the pattern used for cutting composite **34** into individual mats **40**. Alternately, mat **40** may have a printed border around the perimeter thereof.

FIG. 3B shows a cross-section of mat **42**, in which textile panel **6** is surrounded by rubber from rubber layer **32**. Mat **42**, therefore, may be a bordered mat. These borders may have various dimensions, as may be desired by the customer. In some cases, it may be desirable to remove the rubber borders entirely. In addition to, or in lieu of, the rubber border, mat **42** may also include a printed border around the perimeter thereof.

One cut pattern for mats **40** is shown in **FIG. 4A**. Mat composite **34** may be cut along cut lines **38** to produce individual mat units **40**. Cut lines **38** may be made in a variety of positions, as may be desired for mats of varying sizes. Cutting is achieved by any means known in the

art, including manual cutting, mechanical cutting (i.e., with a blade), laser cutting, water jet cutting, ultrasonic cutting, and the like. An electronic sensor, for example, may be used to detect the appropriate cutting positions and to guide the cutting means in making the necessary cuts.

FIG. 4B shows a layout of textile panels **6** on rubber layer **32** to create composite **36**. Again, example cut lines **38** are indicated. As may be appreciated from the drawing, the resultant mats **42** from composite **36** will have a border comprised of rubber.